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Bias in flux partitioning due to the choice of the driving temperature

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Eddy covariance observation systems measure the net ecosystem exchange between vegetation and atmosphere. This net flux is the balance of two major fluxes generated by photosynthesis and respiration. To increase the potential of the data for understanding the mechanisms of the ecosystems response to environmental changes algorithms are applied to partitioning the net flux into the two components gross primary production (GPP) and ecosystem respiration (Reco). The main driver for respiration is temperature, but as respiration takes place in different parts of the ecosystem, e.g. leaves and different soil layers, with different amplitudes and lags between the temperature time series. Often air temperature has been used to model respiration as a large part takes place in the top layer.

Based on the FLUXNET database we quantify in this study the differences in the partitioned flux estimates using air and soil temperature as driver for the respiration in the flux partitioning algorithm. As respiration partly takes place in soil and the vegetation the two scenarios can be seen as extreme cases.

On the annual timescale we find no systematic difference for the Reco estimates. For GPP the estimates using soil temperature are in average 25 gCm-2year-1 lower. The diurnal cycle of the differences reveals, that biases for Reco during nighttime cancel out biases during daytime, while for GPP the biases during daytime sum up as GPP is zero during night. The magnitude of the differences varies between ecosystems and within the season. The differences can be partly explained by properties of the temperature time series, like the lag with the maximum correlation between soil and air temperature or the mean difference between the two temperatures.